[001] FINAL DRIVE FOR DRIVING A VEHICLE WHEEL

[002]

[003] The invention relates to a final drive of a vehicle wheel according to the kind defined in detail in claim 1.

[004]

[005] Final drives for driving a vehicle wheel are mainly used in low-platform buses where each driven wheel of the vehicle has its own drive motor. To obtain a sufficient rear width it is needed to keep as low as possible the axial expansion of the final drive.

[006] In DE 197 09 570 A1 has been disclosed an electric single final drive having several motors in which several motors are not disposed coaxially to the wheel axle and via a first reduction gear drive a second reduction gear, the output of which acts upon the drive wheel. Between the first reduction step and the second reduction step a wheel bearing is situated the same as a brake disk which is located additionally within the extension of the wheel rim of a twin-tire drive wheel. By both reduction gears being disposed separate from each other by the wheel bearing thereoccurs, chiefly in helical-cut toothed wheels due to the displacement action of the reduction gear, a shift of the oil level which disadvantageously acts upon the lubrication of a reduction step. In order compactly to design the final drive in its axial extension and make it possible to prepare the required torque, several electrical drive motors have to be used.

[007] The problem on which this invention is based is to provide a final drive for driving a vehicle wheel which is compactly designed in axial extension and in which the brake is situated in a wheel rim, only one drive motor is used for each final drive, the reduction gear is sufficiently lubricated and that stands out by a good degree of efficiency.

[008] The problem is solved with a final drive according to the preamble of the main claim and also including the features thereof.

[009]

[010] According to the invention the final drive can be decelerated via a brake located within the axial extension of a wheel rim, it being possible that the wheel rim be also a rim for a single tire and in which the brake is placed between the drive motor and the reduction steps. By the reduction steps being disposed directly adjacent, all the moved parts of the toothing can be lubricated by one lubricant which is located within a common space where the reduction steps are placed. Hereby a uniform temperature level results which by virtue of the arrangement of the reduction gear upon the wheel outer side can satisfactorily radiate heat to the environment. The drive motor is not situated coaxially to the wheel axle whereby between wheel rim and drive motor an installation space results where can be placed the brake and the actuation mechanism thereof. The wheel bearing is preferably disposed for absorbing the wheel forces radially above the first reductio gear so that the axial installation space needed b the wheel bearing is available to the drive motor. Thereby the drive motor can be designed with a maximum active length preferably similar or equal to the diameter of the air gap without the total length of the final drive being enlarged thus increasing the degree of efficiency of the drive motor. By the wheel bearing being situated in radial direction outside the first reduction step but being located in the radial extension area of the first reduction step, it is possible to connect the wheel hub, one part of the second reduction step and the bearing flange with the wheel bearing to form a compact unit which also has not to be separated even when disassembling the wheel drive whereby during an assembly in case of servicing the wheel bearing has not to be adjusted again. The second reduction step is preferably designed as planetary gear wherein the planet carrier of the planetary gear forms the output, the ring gear is connected with the hub carrier which carries the wheel bearing and the inner central wheel forms the input. But it is also possible to design the ring gear as output. The inner central wheel is driven by the first reduction step which is preferably designed so that the ring gear forms the output, an input pinion forms the input, which is in intermeshing connection with the ring gear and at least two intermediate wheels, and the carrier which holds the intermediate wheel in

non-turnably retained. By the input pinion being in intermeshing connection directly with the ring gear, the drive motor which drives the input pinion can be situated at a maximum distance from the wheel axle with the result of a sufficient installation space for the brake and the actuation mechanism of the brake. By the input pinion being in intermeshing connection with the ring gear and with at least two intermediate wheels, the torque is distributed on the input pinion with the consequence of an increase in the service life of the input pinion and the first reduction step can thus be compactly designed whereby the diameter of the wheel bearing can be reduced. By the housing of the drive motor transmitting the wheel forces and the mounting pad of the drive motor being located in the area of the load active line on a hub carrier which carries the wheel bearing in which the wheel forces are introduced, the connecting elements of the supporting parts which absorb the wheel forces can be designed smaller in extension , since no additional torque load from a distance to the load active line acts upon the mounting pad and the connecting elements thereof. Hereby the radial extension of the mounting pad of the drive motor housing can be designed so small on the bearing flange that a sealing element can be placed between the non-turnably situated bearing flange and a wheel hub rotating at wheel rotational speed which due to the small radial extension has less peripheral velocities to overcome. The housing of the drive motor can either be connected with an axle bridge or have supporting places on which fastening elements can be situated for fastening the final drive to the vehicle body. Since the drive motor is located on the wheel inner side, the energy can be favorably supplied. Upon the wheel hub fins are preferably situated with upon rotation of the wheel hub set in motion the medium surrounding the wheel hub so that the brake and the final drive are cooled. The housing of the drive motor is preferably flowed through by a coolant which thus cools the drive motor and via the mounting pad of the drive motor also cools the remaining final drive.

[011] A directly adjacent arrangement of the reduction steps and a brake situated between the reduction steps and the drive motor but within the axial and radial extension of a wheel rim create a final drive for driving a vehicle wheel which

stands out by a compact construction, where a drive motor with optimum degree of efficiency can be used and the reduction steps are sufficiently lubricated.

[012]

[013] Other features are to be understood from the description of he figures which show:

[014] Fig. 1 is a final drive for driving a vehicle with double-shear planet carrier; and

[015] Fig. 2 is a final drive for driving a vehicle with double-shear planet carrier.

[016]

[017] The drive motor 1 not coaxially situated relative to the wheel axle is preferably an electric drive motor but may also be a hydraulic or pneumatic drive motor and it drives an input shaft 2 preferably passed into the housing 4 of the drive motor 1 of a first reduction step 3. The housing 4 of the drive motor is preferably cooled by water and is connected with a hub carrier 5 via connecting elements. The mounting pad 6 of the drive motor 1 on the hub carrier 5 is located in the area of a load active line 7 where the wheel forces act upon the final drive. By the mounting pad 6 being situated in the area of the active load line 7, so that none or only small torque loads generated by the vehicle weight act upon the elements which connect the hub carrier 5 with the housing 4 of the drive motor 1. The mounting pad 6 can thus be made small in its radial extension, it being possible upon this diameter to place a sealing element 8 between a wheel hub 9 rotating at the rotational speed of the wheel and the hub carrier 5. Since the radial extension of the mounting pad 6 is small the peripheral velocity of the sealing element 8 is also small, which advantageously acts upon the service life of the sealing element 8. The wheel hub 9 is connected with the planet carrier 10 which forms the output of a second reduction gear 11 and with a wheel rim 12. A wheel bearing 13 supports the wheel hub 9, the ring gear 14, the second reduction step 11, a sealing element 8 and the hub carrier 5 to form a unit which is adjusted only once by the plant and remains complete when the final drive is disassembled for

servicing. On the wheel hub 9 is placed over connecting elements a brake disk 15 by which the wheel hub 9 can be decelerated. The brake disk 15, which is preferably assembled as a divided arrangement but can also be assembled as complete brake disk, is in its axial installation position removed from th sealing element 9 to the extent that a temperature impairment of the brake disk 15 does not occur upon the sealing element 9, on the wheel hub 9 fins are preferably situated with upon rotation of the wheel hub 9 set in motion the medium surrounding the wheel hub 9 so that the brake disk 15 and the complete final drive are cooled. A bearing 17 which supports the inner central wheel 18 of the second reduction step 11 upon the planet carrier 10 rotates only at the differential rotational speed between the inner central wheel 18 and the planet carrier 10 whereby the service life of the bearing is increased. The bearing 17 can also be constructed by an axial thrust plate. If the first reduction step 3 and the second reduction step 11 have a helical-cut design, it is possible to lay out the teeth so that the bearing 17 be free of forces. The housing 4 of the drive motor 1 is preferably connected with an axle bridge 19 but can also be designed with fastening elements for a single-wheel suspension. The first reduction step 3 and the second reduction step 11 are disposed directly adjacent being thus surrounded by a common lubricant whereby the lubrication is ensured for both reduction steps. The wheel bearing 13 is situated radially outside the first reduction step 3 and axially in the area of the first reduction step 3 whereby a very compact final drive can be created. By the wheel bearing 13 being placed radially outside the first reduction step 3 and a taper roller bearing being preferably used on 0-arrangement, a table support of the drive wheel results. The input shaft 2 preferably has on its surface a recess which purposely delivers the lubricant so that the motor bearing 20 remains lubricated. It is also possible eccentrically to design the opening in which the input shaft 2 is situated in order to make available sufficient lubrication to the motor bearing 20. The teeth of the reductions gears 3 and 11 are preferably helical-cut in order to achieve a favorable noise level. The planets 21 of the second reduction gear 11 are floatingly supported whereby the axial length of the final drive is further reduced.

[018] Fig. 2:

A drive motor 1 drives a first reduction step 3 the output of which drives a second reduction step 11 preferably designed as planetary transmission whose planet gears 21 are double-shear supported. The ring gear of the second reduction step 11 can be connected, in a radial direction with the hub carrier 5 either via a screw connection or via safety rings or pins. A rotational speed sensor 22 is placed between the brake disk 15 and the first reduction gear 3. The actuation mechanism 23 of the brake is preferably situated on the side, but it is also possible to actuate the brake via rods outside the wheel.

Reference numerals

1 drive motor
2 input shaft
3 first reduction step
4 housing
5 hub carrier
6 mounting pad
7 load active line
8 sealing element
9 wheel hub
10 planet carrier
11 second reduction step
12 wheel rim
13 wheel bearing
14 ring gear
15 brake disk
16 fins
17 bearing
18 inner central wheel
1 9 axle bridge
20 motor bearing
21 planet gears
22 rotational speed sensor
23 actuation mechanism